Excitation–Contraction Coupling in Smooth Muscle

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Research on smooth muscle is at an interesting juncture; gone are the days when methods, well tried on other tissues, are merely transferred to this muscle and descriptive detail accumulated. Much work is now concerned with establishing features characteristic for smooth muscle and even particular types of smooth muscle. At the same time previous results have come under close scrutiny and a healthy climate of critical disbelief seems established.

Much of this is reflected in the present volume, the Proceedings of the International Symposium in Excitation–Contraction Coupling in Smooth Muscle held in Louvain and Heidelberg in July 1977. The published abstracts, subdivided into nine sections, deal with structural, physiological and biochemical aspects of the problem. Several chairman provide useful summaries of their session, notable examples being H. E. Huxley on structural aspects and S. V. Perry on the role of phosphorylation in contractile regulation.

The area of least controversy now is that concerned with the fine structure of the contractile proteins in vertebrate smooth muscle. The presence of myosin filaments, of fairly regular appearance, of actin filaments and of tropomyosin is no longer in doubt, but the exact position, for example, of tropomyosin along the actin filament has still to be determined.

Lively controversy exists about the chemistry of contractile activation and regulation. Although much good work is going on here, the problem still remains unsolved. Perry and his school see significant amounts of troponin C and I in vertebrate smooth muscle, though not yet troponin T, and they leave the possibility open that troponin may have a similar regulatory function in smooth, as it has in skeletal muscle. On the other hand, Ebashi and co-workers now disown their previous view of activation via troponin and instead propose that small amounts of a new protein (80,000 dalton) serve to facilitate, together with calcium ions, the interaction of myosin and actin. As against this, five other groups hold that the activating effect of calcium proceeds, indirectly, via stimulation of the myosin light chain kinase and that phosphorylation of myosin is responsible for initiating ATPase activity and contraction.

Much critical thinking goes on among physiologists. As in cardiac physiology the limitations of the voltage clamp method on multi-cellular preparations have come to light and a search is under way for criteria to assess which results to believe and which to mistrust.

Measurements of Ca^{2+} tracer fluxes both in whole tissues and in subcellular fractions are reported from many laboratories. Also here, all is not well; shortcomings of the La method have become apparent and, no doubt, the limitation due to the slow time resolution of the tracer method must be in many authors' minds.

It is also becoming clear that there is no simple answer to the question about the origin of the activating calcium in smooth muscle cells; that is whether the ion is discharged from a cellular store or whether it is derived, by influx, from the external medium. Most probably both processes play their part, differing perhaps in importance and extent in different cells and, maybe, even in a given cell depending on the type of contractile activity invoked.

Among other contributions may be singled out that of Endo and colleagues reporting on results from a chemically skinned smooth muscle preparation. There is also a section on mechanics and energetics of smooth muscle contraction.

This is clearly a useful book bringing the reader up to date on this topic.

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